

**REMARKS****A. Status of Claims**

The Office Action dated January 8, 2009 has been reviewed, and the comments of the U.S. Patent Office have been considered. Claims 2, 3, 5, 6, 9, 11, 13, 14, 15, 19, 20, 24 and 25 have been amended, new Claim 50 has been added, and Claim 1 has been cancelled. Claims 21 and 26-49 have been previously withdrawn. Claims 2-20, 22-25 and 50 are currently pending and under consideration. Favorable reconsideration of this application is respectfully requested.

**B. Support for New Claim 50**

Support for new Claim 50 may be found in the specification at paragraphs [0013], [0040] and [0065], [0110], and [0111]<sup>1</sup> and in drawing FIGS. 2A, 2B, 3A and 3C, as well as elsewhere in the originally filed specification, drawings and claims.

**C. Procedural Matters**

Applicants note, with thanks, the Examiner's acknowledgement of the acceptance of drawings filed July 20, 2006.

Applicants also note, with thanks, the Examiner's acknowledgement of the acceptance of receipt of papers submitted under 35 U.S.C. § 119(a)-(d).

Applicants further note, with thanks, the Examiner's acceptance of the Information Disclosure Statements filed on July 20, 2006 and November 29, 2007, and the notation by the Examiner that all references listed in the accompanying SB08 forms have been considered and made of record.

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<sup>1</sup> All references to the specification are to U.S. Application No. 2008/024583 published October 9, 2008.

**D. Examiner Interviews**

Applicants wish to thank Examiners Patel and Ward for the courtesies extended to Applicants' representative during an Examiner Interview of February 19, 2009 (1<sup>st</sup> Examiner Interview). Applicants also wish to thank Examiner Patel for the courtesies extended to Applicants' representative during an Examiner Interview on March 3, 2009 (2<sup>nd</sup> Examiner Interview). During the 1<sup>st</sup> Examiner Interview, Applicants' representative pointed out that U.S. Patent Publication No. 2004/0169020 to Yamauchi (hereinafter "**Yamauchi**") specifically teaches at paragraph [0143] that a temperature of 150°C. to 200°C. is required for gold/gold bonding. In response, the Examiners requested time to review **Yamauchi**. Therefore, Applicants' representative requested the 2<sup>nd</sup> Examiner Interview to discuss **Yamauchi** with Examiner Patel. During the 2<sup>nd</sup> Examiner Interview, it was agreed between Examiner Patel and Applicants' representative that **Yamauchi does not teach or suggest the claimed feature of gold/gold bonding at room temperature** for at least the reasons discussed below.

**E. Response to Rejection of Claims 1-2, 5-6, 8, 15, 17-19, and 22-25 under 35 U.S.C. § 102(b) as Being Anticipated by Yamauchi**

At pages 2-4 of the Office Action, Claims 1-2, 5-6, 8, 15, 17-19 and 22-25 are rejected under 35 U.S.C. § 102(b) as being anticipated by WO 2003/001858 (of which **Yamauchi** is the English-language equivalent). This rejection is respectfully traversed in part and rendered moot in part.

Claims 2, 5-6, 8, 15, 17-19 and 22-25 each recite the features of metal "a bonding method for bonding objects to be bonded which have a bonding portion formed of a metal, wherein bonding portions, which have a **hardness of 200 Hv or less**, are contacted with each other and pressed in a solid phase at **room temperature . . . wherein said bonding portion is formed of gold**,"<sup>2</sup>

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<sup>2</sup>Claim 2 explicitly recites these features, and Claims 5-6, 8, 15, 17-19 and 22-25, as currently presented, depend from Claim 2, at least indirectly, and, therefore, also include these features.

In rejecting Claims 2, 5-6, 8, 15, 17-19 and 22-25 under 35 U.S.C. § 102(b) as being anticipated by **Yamauchi**, the Office Action relies upon the following allegation:

***Allegation 1***

Regarding claim 1, **Yamauchi** discloses a bonding method [fig. 1] for bonding objects to be bonded which have a bonding portion (4,5) formed of a metal, wherein the bonding portions are **gold/gold bonding** [¶ 143], which inherently have a hardness of 200 Hv or less, are contacted with each other and pressed in solid phase **at room temperature** [¶ 8-11] after treating the bonding portions with plasma [¶ 142, 12].<sup>3</sup>

But, as discussed during the 1<sup>st</sup> and 2<sup>nd</sup> Examiner Interviews, Allegation 1 is explicitly contradicted by paragraph [0143] of **Yamauchi** which states:

**Yamauchi, Paragraph [0143]**

[0143] At that time, a heater may be incorporated into tool 7 and heating together with the above-described pressing may be carried out. A further easier bonding becomes possible by heating. However, because the surfaces of bumps 4 and pads 5 are activated by cleaning and they are in a condition being bonded very easily, a high-temperature heating such as a case of a conventional bonding by merely heating is not necessary. For example, in a case of **gold/gold bonding**, although a high-temperature heating of about 400°C. has been required in a conventional heat-bonding method, in the method according to the present invention, bonding becomes possible by heating at a temperature of about **150°C. to 200°C.** Further, also for ultrasonic bonding, the bonding may be facilitated by activating the surfaces of the metal connection parts by cleaning.<sup>4</sup>

As can be seen above, **Yamauchi** teaches using a gold/gold bonding temperature of 150°C to 200°C, **which is 125 degrees greater than 25°C (i.e., room temperature)**. Therefore, as agreed during the Examiner Interview and contrary to what Allegation 1 says or suggests, **Yamauchi cannot teach or suggest the claimed feature of gold/gold bonding at room temperature.** Furthermore, nowhere does **Yamauchi** teach or suggest the claimed feature of

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<sup>3</sup> See Office Action, p. 2 (emphasis added).

<sup>4</sup> Emphasis added.

bonding objects at room temperature using solid phase metal bonding portions which have a **hardness of 200 Hv or less**. Accordingly, **Yamauchi** cannot teach or suggest all features of the claimed invention.

In addition, in **Yamauchi** the bonding portions may only be bonded together if they are still completely clean from being treated with plasma. More specifically, **Yamauchi** states that “Since the bonding carried out immediately after oxide films and organic substances on the surfaces are removed by the energy wave or energy particles and **reformation of the oxide films and organic substances can be maintained to be prevented**, bonding at an atmospheric pressure, particularly, bonding substantially in air with an atmospheric pressure, becomes possible.”<sup>5</sup> In contrast, **in the process of the present invention, the bonding portions do not need to be completely clean**. The present invention assumes that a thin layer of adhering substances such as organic substances, oxide films or the like may form on the bonding surface after cleaning the bonding surface.<sup>6</sup>

To overcome the problem posed by the presence of a thin layer of adhering substances on the bonding surface, the present invention employs a bonding portion of a soft metal, such as gold, that may be crushed when pressed to expose clean bonding surfaces that may be used for bonding. This process is described in paragraph [0013] of the present application as follows: “. . . when objects to be bonded are bonded in a low vacuum of  $10^{-5}$  Torr or more or in the atmospheric air after cleaning, an adhering substance layer is formed on the bonding surface, so that the objects to be bonded are not bonded only by contacting directly. However, since the adhering substance layer is thin immediately after the surface activating treatment, a bonding interface is spread by crushing the adhering substance layer to perform bonding, so that a new surface appears on a bonding surface, and the objects to be bonded are bonded together. In order to crush the adhering substance layer more easily, a bonding metal of a bonding portion of the object to be bonded needs to have a low hardness. According to the results of various experiments conducted by the present inventors, it was found that the hardness of the bonding portion which is a Vickers hardness of 200 Hv or less, preferably 20 Hv to 200 Hv, is particularly effective for room-temperature bonding (see FIG. 1).”

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<sup>5</sup> See **Yamauchi**, paragraph [0012], emphasis added.

<sup>6</sup> See paragraph [0040].

This process is also shown in FIGS. 2A, 2B, 3A and 3B and is further described in paragraph [0040] which states that “since the adhering substance layer is thin immediately after cleaning, bonding can be achieved by the following method. This is because, as illustrated in FIG. 2A, by providing minute irregularities on the bonding surface, the convex portions are crushed by pressing to be spread, so that a new surface appears and bonding is achieved (see FIG. 2B). When viewed microscopically, crystal orientations arranged as illustrated in FIGS. 3A and 3B are rotated by the convex portion being crushed, so that the new surface appears.”<sup>7</sup>

Therefore, **Yamauchi** cannot teach or suggest the method of Claims 2, 5-6, 8, 15, 17-19 and 22-25 for this additional reason.

For at least the above reasons, the rejection of Claims 2, 5-6, 8, 15, 17-19 and 22-25 under 35 U.S.C. § 102(b) as being anticipated by **Yamauchi** is *prima facie* improper, and therefore these Claims should be considered patentable over **Yamauchi**.

In addition, the rejection of Claim 1 under 35 U.S.C. § 102(b) as being anticipated by **Yamauchi** has been rendered moot by the cancellation of this claim.

**F. Response to Rejection of Claims 3-4 and 14 under 35 U.S.C. § 103(a) as Being Unpatentable over Yamauchi, in View of Gilleo**

At pages 5-6 of the Office Action, Claims 3-4 and 14 are rejected under 35 U.S.C. § 103(a) as being unpatentable over **Yamauchi**, in view of U.S. Patent No. 5,971,253 to Gilleo (hereinafter “**Gilleo**”). This rejection is respectfully traversed.

Claims 3-4 and 14, as currently presented, depend from Claim 2, at least indirectly. Claim 2 is patentable over **Yamauchi** for at least the reasons discussed above discussed in Section D. **Gilleo** does not teach or suggest the claimed feature of **bonding objects at room temperature using solid phase metal bonding portions which have hardness of 200 Hv or less**. Accordingly, **Gilleo** cannot remedy the failure of **Yamauchi** to teach or suggest this claimed feature, and thus the combination of **Yamauchi** and **Gilleo** cannot teach or suggest this

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<sup>7</sup> See paragraph [0040] and FIGS. 2A, 2B, 3A and 3B.

claimed feature. Therefore, Claim 2 is patentable over the combination of **Yamauchi** and **Gilleo**.

Because Claims 3-4 and 14 depend from Claim 2, at least indirectly, these dependent claims are also patentable over the combination of **Yamauchi** and **Gilleo** for at least the reasons discussed above for why Claim 2 is patentable over this combination.

**G. Response to Rejection of Claim 7 under 35 U.S.C. § 103(a) as Being Unpatentable over Yamauchi, in View of Linn**

At page 6 of the Office Action, Claim 7 is rejected under 35 U.S.C. § 103(a) as being unpatentable over **Yamauchi**, in view of U.S. Patent No. 5,833,758 to Linn *et al.* (hereinafter “**Linn**”). This rejection is respectfully traversed.

Claim 7, as currently presented, depends from Claim 2, at least indirectly. Claim 2 is patentable over **Yamauchi** for at least the reasons discussed above discussed in Section D. **Linn** does not teach or suggest the claimed feature of **bonding objects at room temperature using solid phase metal bonding portions which have hardness of 200 Hv or less**. Accordingly, **Linn** cannot remedy the failure of **Yamauchi** to teach or suggest this claimed feature, and thus the combination of **Yamauchi** and **Linn** cannot teach or suggest this claimed feature. Therefore, Claim 2 is patentable over the combination of **Yamauchi** and **Linn**.

Because Claim 7 depends from Claim 2, at least indirectly, this dependent claim is also patentable over the combination of **Yamauchi** and **Linn** for at least the reasons discussed above for why Claim 2 is patentable over this combination.

**H. Response to Rejection of Claims 9-10 under 35 U.S.C. § 103(a) as Being Unpatentable over Yamauchi, in View of Linn and Usui I.**

At pages 6-8 of the Office Action, Claims 9-10 are rejected under 35 U.S.C. § 103(a) as being unpatentable over **Yamauchi**, in view of **Linn** and **Usui**, U.S. Patent Publication No. 2004/0140551 to Usui *et al.* (hereinafter “**Usui I**”). This rejection is respectfully traversed.

Claims 9-10, as currently presented, depend from Claim 2, at least indirectly. Claim 2 is patentable over the combination of **Yamauchi** and **Linn** for at least the reasons discussed above discussed in Section D. **Usui I** does not teach or suggest the claimed feature of **bonding objects at room temperature using solid phase metal bonding portions which have hardness of 200 Hv or less.** Accordingly, **Usui I** cannot remedy the failure of the combination of **Yamauchi** and **Linn** to teach or suggest this claimed feature, and thus the combination of **Yamauchi** and **Linn** with **Usui I** cannot teach or suggest this claimed feature. Therefore, Claim 2 is patentable over the combination of **Yamauchi** and **Linn** with **Usui I**.

Because Claims 9-10 depend from Claim 2, at least indirectly, these claims are also patentable over the combination of **Yamauchi** and **Linn** with **Usui I** for at least the reasons discussed above for why Claim 2 is patentable over this combination.

**I. Response to Rejection of Claims 11-12 and 20 under 35 U.S.C. § 103(a) as Being Unpatentable over Yamauchi, in View of Yagi**

At pages 8-9 of the Office Action, Claims 11-12 and 20 are rejected under 35 U.S.C. § 103(a) as being unpatentable over **Yamauchi**, in view of U.S. Patent No. 5,686,353 to Yagi *et al.* (hereinafter “**Yagi**”). This rejection is respectfully traversed.

Claims 11-12 and 20, as currently presented, depend from Claim 2, at least indirectly. Claim 2 is patentable over **Yamauchi** for at least the reasons discussed above discussed in Section D. **Yagi** does not teach or suggest the claimed feature of **bonding objects at room temperature using solid phase metal bonding portions which have hardness of 200 Hv or less.** Accordingly, **Yagi** cannot remedy the failure of **Yamauchi** to teach or suggest this claimed

feature, and thus the combination of **Yamauchi** and **Yagi** cannot teach or suggest this claimed feature. Therefore, Claim 2 is patentable over the combination of **Yamauchi** and **Yagi**.

Because Claims 11-12 and 20 depend from Claim 2, at least indirectly, Claims 11-12 and 20 are also patentable over the combination of **Yamauchi** and **Yagi** for at least the reasons discussed above for why Claim 2 is patentable over this combination.

**J. Response to Rejection of Claim 13 under 35 U.S.C. § 103(a) as Being Unpatentable over Yamauchi**

At pages 9-10 of the Office Action, Claim 13 is rejected under 35 U.S.C. § 103(a) as being unpatentable over **Yamauchi**, in view of U.S. Patent Publication No. 2004/0169020. This rejection is respectfully traversed.

Claim 13, as currently presented, depends from Claim 2. Claim 2 is patentable over **Yamauchi** for at least the reasons discussed above discussed in Section D. Because Claim 13 depends from Claim 2, Claim 13 is also patentable over **Yamauchi** for at least the reasons discussed above that Claim 2 is patentable over **Yamauchi**.

**K. Response to Rejection of Claim 16 under 35 U.S.C. § 103(a) as Being Unpatentable over Yamauchi, in View of Usui II**

At page 10 of the Office Action, Claim 16 is rejected under 35 U.S.C. § 103(a) as being unpatentable over **Yamauchi**, in view of U.S. Patent No. 5,686,353 to Usui *et al.* (hereinafter “**Usui II**”). This rejection is respectfully traversed.

Claim 16, as currently presented, depends from Claim 2, at least indirectly. Claim 2 is patentable over **Yamauchi** for at least the reasons discussed above discussed in Section D. **Usui II** does not teach or suggest the claimed feature of **bonding objects at room temperature using solid phase metal bonding portions which have hardness of 200 Hv or less**. Accordingly, **Usui II** cannot remedy the failure of **Yamauchi** to teach or suggest this claimed feature, and thus



the combination of **Yamauchi** and **Usui II** cannot teach or suggest this claimed feature. Therefore, Claim 2 is patentable over the combination of **Yamauchi** and **Usui II**.

Because Claim 16 depends from Claim 2, at least indirectly, this claim is also patentable over the combination of **Yamauchi** with **Usui II** for at least the reasons discussed above for why Claim 2 is patentable over this combination.

**L. Patentability of New Claim 50 over Cited References**

As discussed in Section E above, in **Yamauchi** the bonding portions may only be bonded together if they are still completely clean after being treated with plasma. In contrast, the bonding portions do not need to be completely clean in the method of Claim 50. The method of Claim 50 specifically addresses the situation where a thin layer of adhering substances such as organic substances, oxide films or the like readhere to the bonding surface after cleaning the bonding surface. Therefore, for at least this reason, **Yamauchi cannot teach or suggest the method of Claim 50.**

Also, **Gilleo, Linn, Usui I, Yagi and Usui II**, either taken alone or in combination with each other or **Yamauchi**, fail to teach or suggest the claimed feature of a bonding method that bonds two objects together by pressing bonding surfaces that are in a solid phase at a temperature of room temperature to 180°C to thereby crush an adhering substance layer formed on the bonding portions.

For at least the above reasons, Claim 50 is patentable over all of the currently cited references.

**M. Conclusion**

In view of the foregoing amendments and remarks, Applicant respectfully requests reconsideration of this Application and the prompt allowance of at least Claims 2-20, 22-25 and 50.

Should the Examiner feel that there are any issues outstanding after consideration of this response, the Examiner is invited to contact the undersigned to expedite prosecution of the application.

The Commissioner is hereby authorized by this paper to charge any fees during the entire pendency of this application including fees due under 37 C.F.R. §§ 1.16 and 1.17 which may be required, including any required extension of time fees, or credit any overpayment to Deposit Account 10-0233. **This paragraph is intended to be a CONSTRUCTIVE PETITION FOR EXTENSION OF TIME in accordance with 37 C.F.R. § 1.136(a)(3).**

Respectfully submitted,

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